Key Terms

absolute threshold minimum amount of stimulus energy that must be present for the stimulus to be detected 50% of the time

afterimage continuation of a visual sensation after removal of the stimulus

amplitude height of a wave

basilar membrane thin strip of tissue within the cochlea that contains the hair cells which serve as the sensory receptors for the auditory system

binaural cue two-eared cue to localize sound

binocular cue cue that relies on the use of both eyes

binocular disparity slightly different view of the world that each eye receives

blind spot point where we cannot respond to visual information in that portion of the visual field

bottom-up processing system in which perceptions are built from sensory input

closure organizing our perceptions into complete objects rather than as a series of parts

cochlea fluid-filled, snail-shaped structure that contains the sensory receptor cells of the auditory system

cochlear implant electronic device that consists of a microphone, a speech processor, and an electrode array to directly stimulate the auditory nerve to transmit information to the brain

conductive hearing loss failure in the vibration of the eardrum and/or movement of the ossicles

cone specialized photoreceptor that works best in bright light conditions and detects color

congenital deafness deafness from birth

congenital insensitivity to pain (congenital analgesia) genetic disorder that results in the inability to experience pain

cornea transparent covering over the eye

deafness partial or complete inability to hear

decibel (dB) logarithmic unit of sound intensity

depth perception ability to perceive depth

electromagnetic spectrum all the electromagnetic radiation that occurs in our environment

figure-ground relationship segmenting our visual world into figure and ground

fovea small indentation in the retina that contains cones

frequency number of waves that pass a given point in a given time period

Gestalt psychology field of psychology based on the idea that the whole is different from the sum of its parts

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good continuation (also, continuity) we are more likely to perceive continuous, smooth flowing lines rather than jagged, broken lines

hair cell auditory receptor cell of the inner ear

hertz (Hz) cycles per second; measure of frequency

inattentional blindness failure to notice something that is completely visible because of a lack of attention

incus middle ear ossicle; also known as the anvil

inflammatory pain signal that some type of tissue damage has occurred

interaural level difference sound coming from one side of the body is more intense at the closest ear because of the attenuation of the sound wave as it passes through the head

interaural timing difference small difference in the time at which a given sound wave arrives at each ear

iris colored portion of the eye

just noticeable difference difference in stimuli required to detect a difference between the stimuli

kinesthesia perception of the body's movement through space

lens curved, transparent structure that provides additional focus for light entering the eye

linear perspective perceive depth in an image when two parallel lines seem to converge

Meissner's corpuscle touch receptor that responds to pressure and lower frequency vibrations

Merkel's disk touch receptor that responds to light touch

Ménière's disease results in a degeneration of inner ear structures that can lead to hearing loss, tinnitus, vertigo, and an increase in pressure within the inner ear

malleus middle ear ossicle; also known as the hammer

monaural cue one-eared cue to localize sound

monocular cue cue that requires only one eye

neuropathic pain pain from damage to neurons of either the peripheral or central nervous system

nociception sensory signal indicating potential harm and maybe pain

olfactory bulb bulb-like structure at the tip of the frontal lobe, where the olfactory nerves begin

olfactory receptor sensory cell for the olfactory system

opponent-process theory of color perception color is coded in opponent pairs: black-white, yellow-blue, and red-green

optic chiasm X-shaped structure that sits just below the brain's ventral surface; represents the merging of the optic nerves from the two eyes and the separation of information from the two sides of the visual field to the opposite side of the brain

optic nerve carries visual information from the retina to the brain

Pacinian corpuscle touch receptor that detects transient pressure and higher frequency vibrations

pattern perception ability to discriminate among different figures and shapes

peak (also, crest) highest point of a wave

perception way that sensory information is interpreted and consciously experienced

perceptual hypothesis educated guess used to interpret sensory information

pheromone chemical message sent by another individual

photoreceptor light-detecting cell

pinna visible part of the ear that protrudes from the head

pitch perception of a sound's frequency

place theory of pitch perception different portions of the basilar membrane are sensitive to sounds of different frequencies

principle of closure organize perceptions into complete objects rather than as a series of parts

proprioception perception of body position

proximity things that are close to one another tend to be grouped together

pupil small opening in the eye through which light passes

Ruffini corpuscle touch receptor that detects stretch

retina light-sensitive lining of the eye

rod specialized photoreceptor that works well in low light conditions

sensation what happens when sensory information is detected by a sensory receptor

sensorineural hearing loss failure to transmit neural signals from the cochlea to the brain

sensory adaptation not perceiving stimuli that remain relatively constant over prolonged periods of time

signal detection theory change in stimulus detection as a function of current mental state

similarity things that are alike tend to be grouped together

stapes middle ear ossicle; also known as the stirrup

subliminal message message presented below the threshold of conscious awareness

taste bud grouping of taste receptor cells with hair-like extensions that protrude into the central pore of the taste bud

temporal theory of pitch perception sound's frequency is coded by the activity level of a sensory neuron

thermoception temperature perception

timbre sound's purity

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top-down processing interpretation of sensations is influenced by available knowledge, experiences, and thoughts

transduction conversion from sensory stimulus energy to action potential

trichromatic theory of color perception color vision is mediated by the activity across the three groups of cones

trough lowest point of a wave

tympanic membrane eardrum

umami taste for monosodium glutamate

vertigo spinning sensation

vestibular sense contributes to our ability to maintain balance and body posture

visible spectrum portion of the electromagnetic spectrum that we can see

wavelength length of a wave from one peak to the next peak

Summary

5.1 Sensation versus Perception
Sensation occurs when sensory receptors detect sensory stimuli. Perception involves the organization, interpretation, and conscious experience of those sensations. All sensory systems have both absolute and difference thresholds, which refer to the minimum amount of stimulus energy or the minimum amount of difference in stimulus energy required to be detected about 50% of the time, respectively. Sensory adaptation, selective attention, and signal detection theory can help explain what is perceived and what is not. In addition, our perceptions are affected by a number of factors, including beliefs, values, prejudices, culture, and life experiences.

5.2 Waves and Wavelengths
Both light and sound can be described in terms of wave forms with physical characteristics like amplitude, wavelength, and timbre. Wavelength and frequency are inversely related so that longer waves have lower frequencies, and shorter waves have higher frequencies. In the visual system, a light wave's wavelength is generally associated with color, and its amplitude is associated with brightness. In the auditory system, a sound's frequency is associated with pitch, and its amplitude is associated with loudness.

5.3 Vision
Light waves cross the cornea and enter the eye at the pupil. The eye's lens focuses this light so that the image is focused on a region of the retina known as the fovea. The fovea contains cones that possess high levels of visual acuity and operate best in bright light conditions. Rods are located throughout the retina and operate best under dim light conditions. Visual information leaves the eye via the optic nerve. Information from each visual field is sent to the opposite side of the brain at the optic chiasm. Visual information then moves through a number of brain sites before reaching the occipital lobe, where it is processed.

Two theories explain color perception. The trichromatic theory asserts that three distinct cone groups are tuned to slightly different wavelengths of light, and it is the combination of activity across these cone types that results in our perception of all the colors we see. The opponent-process theory of color vision asserts that color is processed in opponent pairs and accounts for the interesting phenomenon of a negative afterimage. We perceive depth through a combination of monocular and binocular depth cues.

5.4 Hearing

Sound waves are funneled into the auditory canal and cause vibrations of the eardrum; these vibrations move the ossicles. As the ossicles move, the stapes presses against the oval window of the cochlea, which causes fluid inside the cochlea to move. As a result, hair cells embedded in the basilar membrane become enlarged, which sends neural impulses to the brain via the auditory nerve.

Pitch perception and sound localization are important aspects of hearing. Our ability to perceive pitch relies on both the firing rate of the hair cells in the basilar membrane as well as their location within the membrane. In terms of sound localization, both monaural and binaural cues are used to locate where sounds originate in our environment.

Individuals can be born deaf, or they can develop deafness as a result of age, genetic predisposition, and/or environmental causes. Hearing loss that results from a failure of the vibration of the eardrum or the resultant movement of the ossicles is called conductive hearing loss. Hearing loss that involves a failure of the transmission of auditory nerve impulses to the brain is called sensorineural hearing loss.

5.5 The Other Senses

Taste (gustation) and smell (olfaction) are chemical senses that employ receptors on the tongue and in the nose that bind directly with taste and odor molecules in order to transmit information to the brain for processing. Our ability to perceive touch, temperature, and pain is mediated by a number of receptors and free nerve endings that are distributed throughout the skin and various tissues of the body. The vestibular sense helps us maintain a sense of balance through the response of hair cells in the utricle, saccule, and semi-circular canals that respond to changes in head position and gravity. Our proprioceptive and kinesthetic systems provide information about body position and body movement through receptors that detect stretch and tension in the muscles, joints, tendons, and skin of the body.

5.6 Gestalt Principles of Perception

Gestalt theorists have been incredibly influential in the areas of sensation and perception. Gestalt principles such as figure-ground relationship, grouping by proximity or similarity, the law of good continuation, and closure are all used to help explain how we organize sensory information. Our perceptions are not infallible, and they can be influenced by bias, prejudice, and other factors.

Review Questions

1. _____ refers to the minimum amount of stimulus energy required to be detected 50% of the time.

a. absolute threshold
b. difference threshold
c. just noticeable difference
d. transduction

2. Decreased sensitivity to an unchanging stimulus is known as _____.

a. transduction
b. difference threshold
c. sensory adaptation
d. inattentional blindness

3. _____ involves the conversion of sensory stimulus energy into neural impulses.

a. sensory adaptation
b. inattentional blindness
c. difference threshold
d. transduction

4. _____ occurs when sensory information is organized, interpreted, and consciously experienced.

a. sensation
b. perception
c. transduction
d. sensory adaptation

5. Which of the following correctly matches the pattern in our perception of color as we move from short wavelengths to long wavelengths?

a. red to orange to yellow
b. yellow to orange to red
c. yellow to red to orange
d. orange to yellow to red

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6. The visible spectrum includes light that ranges from about _____.
a. 400–700 nm
b. 200–900 nm
c. 20–20000 Hz
d. 10–20 dB

7. The electromagnetic spectrum includes _____.
a. radio waves
b. x-rays
c. infrared light
d. all of the above

8. The audible range for humans is _____.
a. 380–740 nm
b. 10–20 dB
c. 20–20,000 dB
d. less than 300 nm

9. The quality of a sound that is affected by frequency, amplitude, and timing of the sound wave is known as _____.
a. pitch
b. tone
c. electromagnetic
d. timbre

10. The _____ is a small indentation of the retina that contains cones.
a. optic chiasm
b. optic nerve
c. fovea
d. iris

11. _____ operate best under bright light conditions.
a. cones
b. rods
c. retinal ganglion cells
d. striate cortex

12. _____ depth cues require the use of both eyes.
a. monocular
b. binocular
c. linear perspective
d. accommodating

13. If you were to stare at a green dot for a relatively long period of time and then shift your gaze to a blank white screen, you would see a _____ negative afterimage.
a. blue
b. yellow
c. black
d. red

14. Hair cells located near the base of the basilar membrane respond best to _____ sounds.
a. low-frequency
b. high-frequency
c. low-amplitude
d. high-amplitude

15. The three ossicles of the middle ear are known as _____.
a. malleus, incus, and stapes
b. hammer, anvil, and stirrup
c. pinna, cochlea, and urticle
d. both a and b

16. Hearing aids might be effective for treating _____.
a. Ménière's disease
b. sensorineural hearing loss
c. conductive hearing loss
d. interaural time differences

17. Cues that require two ears are referred to as _____ cues.
a. monocular
b. monaural
c. binocular
d. binaural

18. Chemical messages often sent between two members of a species to communicate something about reproductive status are called _____.
a. hormones
b. pheromones
c. Merkel’s disks
d. Meissner’s corpuscles

19. Which taste is associated with monosodium glutamate?
a. sweet
b. bitter
c. umami
d. sour

20. _____ serve as sensory receptors for temperature and pain stimuli.
a. free nerve endings
b. Pacinian corpuscles
c. Ruffini corpuscles
d. Meissner's corpuscles

21. Which of the following is involved in maintaining balance and body posture?
a. auditory nerve
b. nociceptors
c. olfactory bulb
d. vestibular system

22. According to the principle of _____, objects that occur close to one another tend to be grouped together.
a. similarity
b. good continuation
c. proximity
d. closure

23. Our tendency to perceive things as complete objects rather than as a series of parts is known as the principle of _____.
a. closure
b. good continuation
c. proximity
d. similarity

24. According to the law of _____, we are more likely to perceive smoothly flowing lines rather than choppy or jagged lines.
a. closure
b. good continuation
c. proximity
d. similarity

25. The main point of focus in a visual display is known as the _____.
a. closure
b. perceptual set
c. ground
d. figure

Critical Thinking Questions

26. Not everything that is sensed is perceived. Do you think there could ever be a case where something could be perceived without being sensed?

27. Please generate a novel example of how just noticeable difference can change as a function of stimulus intensity.

28. Why do you think other species have such different ranges of sensitivity for both visual and auditory stimuli compared to humans?

29. Why do you think humans are especially sensitive to sounds with frequencies that fall in the middle portion of the audible range?

30. Compare the two theories of color perception. Are they completely different?

31. Color is not a physical property of our environment. What function (if any) do you think color vision serves?

32. Given what you've read about sound localization, from an evolutionary perspective, how does sound localization facilitate survival?

33. How can temporal and place theories both be used to explain our ability to perceive the pitch of sound waves with frequencies up to 4000 Hz?

34. Many people experience nausea while traveling in a car, plane, or boat. How might you explain this as a function of sensory interaction?

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35. If you heard someone say that they would do anything not to feel the pain associated with significant injury, how would you respond given what you've just read?

36. Do you think women experience pain differently than men? Why do you think this is?

37. The central tenet of Gestalt psychology is that the whole is different from the sum of its parts. What does this mean in the context of perception?

38. Take a look at the following figure. How might you influence whether people see a duck or a rabbit?

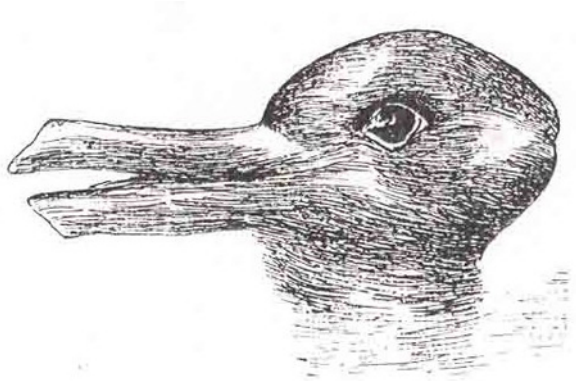

Figure 5.28

Personal Application Questions

39. Think about a time when you failed to notice something around you because your attention was focused elsewhere. If someone pointed it out, were you surprised that you hadn't noticed it right away?

40. If you grew up with a family pet, then you have surely noticed that they often seem to hear things that you don't hear. Now that you've read this section, you probably have some insight as to why this may be. How would you explain this to a friend who never had the opportunity to take a class like this?

41. Take a look at a few of your photos or personal works of art. Can you find examples of linear perspective as a potential depth cue?

42. If you had to choose to lose either your vision or your hearing, which would you choose and why?

43. As mentioned earlier, a food's flavor represents an interaction of both gustatory and olfactory information. Think about the last time you were seriously congested due to a cold or the flu. What changes did you notice in the flavors of the foods that you ate during this time?

44. Have you ever listened to a song on the radio and sung along only to find out later that you have been singing the wrong lyrics? Once you found the correct lyrics, did your perception of the song change?

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